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Notes on the Herpetofauna of Nayarit, Mexico 6: Amphibians and Reptiles of the Municipality of Bahía de Banderas

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Abstract

We provide the first list of the amphibians and reptiles of the municipality of Bahía de Banderas, Nayarit, Mexico. We carried out a historical review of the herpetological records of the municipality and complemented them with our own records. We recognized a total of 1494 organisms, belonging to 72 species of herpetozoans, representing 30 families and 58 genera; these include 19 species of amphibians (all anurans) and 53 reptiles (one crocodile, 18 lizards, 26 snakes and eight turtles). Of the 72 species included in Bahía de Banderas, 13 amphibians and 31 reptiles are endemic to Mexico. Twenty-eight of the non-endemic species are native; in addition, six introduced species are present. The most represented amphibian family is Hylidae with seven species, and the most represented reptile family is Colubridae with 11 species. Additionally, we present the conservation status of all herpetofauna species present in the municipality of Bahía de Banderas, as well as the diversity of the vegetation present in the municipality and a comparison with lists of other municipalities.

Keywords: Amphibians, Herpetozoa, Reptiles, Banderas Bay, Nayarit, Mexico

Resumen

Se proporciona el primer listado de los anfibios y reptiles del municipio de Bahía de Banderas, Nayarit, México. Realizamos una revisión histórica de los registros herpetológicos del municipio y los complementamos con registros propios. Se reconocieron un total de 1494 organismos, pertenecientes a 72 especies de herpetozoos, que representan 30 familias y 58 géneros, estos incluyen 19 especies de anfibios (todos anuros) y 53 reptiles (un cocodrilo, 18 lagartos, 26 serpientes y 8 tortugas). De las 72 especies incluidas en Bahía de Banderas: 13 anfibios y 31 reptiles son endémicos de México y 28 son nativos, además, están presentes seis especies introducidas. La familia de anfibios más representada incluye Hylidae con siete especies, y la familia de reptiles más representada es Colubridae con 11 especies. Adicionalmente, presentamos el estado de conservación de todas las especies de herpetofauna presentes en el municipio de Bahía de Banderas, así como la presencia de diversidad en la vegetación presente en el municipio y una comparación con listados de otros municipios actualmente presentes.

Palabras clave: Anfibios, Herpetozoos, Reptiles, Bahía de Banderas, Nayarit, México

Introduction

The amphibians and reptiles of Bahía de Banderas have been surveyed, taxonomically studied and documented during the last 60 years, thanks to American researchers interested in studying the herpetofauna in western Mexico (e.g., Duellman and Wellman, 1960). Until now, the only reports on the herpetofauna of Bahía de Banderas, Nayarit, were publications by Duellman and Wellman (op. cit.), Webb (1971) and Ahumada-Carrillo et al. (2013), as well as two local inventories: Fuentes-Castrejón and Maldonado-Gasca (2015) and Miramontes (2017). However, a formal inventory of amphibian and reptile fauna in a meticulous and precise manner is not yet documented for the municipality. Currently, Bahía de Banderas is a region of Nayarit that is rapidly developing, with an accompanying increase of fragmented habitats, due to urbanization (Figure 1), and road infrastructure development (Figure 2). The purpose of this research is to document the municipal herpetofauna composition, including abundance numbers, vegetation types and conservation status. A more extensive inventory of the herpetofauna of the state is provided by Loc-Barragán et al. (2024). These findings could be a useful, reliable and accurate tool to ensure the protection of the municipal herpetofauna and can provide a basis for scientific studies and future programs for management and conservation.

Figure 1. Deforestation for urbanization in the vicinity of Mezcales, Bahía de Banderas, Nayarit.

Figure 2. Deforestation as a consequence of the development of road infrastructure in Bahía de Banderas, Nayarit.

The present paper follows the general format of previous documents for the herpetofauna of the municipalities of Tecuala, Compostela and Huajicori (Loc-Barragán and Lazcano, 2018; Loc-Barragán et al., 2018; Loc-Barragán et al., 2019).

Study site (Biogeography)

Bahía de Banderas is located in the south of Nayarit (Figure 3). It is one of 20 municipalities of the state, which shares the northernmost tip with the Sierra Madre de Sur biogeographic province, adjacent to the Sierra subprovinces of the coast of Colima and Jalisco (INEGI, 2010). The municipality is bordered to the north by the Pacific Ocean and the municipality of Compostela; to the east by the municipality of Compostela and the state of Jalisco; to the south by the state of Jalisco and the Pacific Ocean; to the west by the Pacific Ocean. In terms of latitude and longitude, it lies between 20°40' and 21°00' North latitude, and between 104°58' and 105°33' West longitude. The municipality represents 2.79% of the state's surface area with an area of 773.3 km^2. Tropical Forest vegetation covers 69.17% of the area, represented by the following dominant species: copperwood (*Bursera simaruba*), guacuyule palm (*Orbignya guacuyule*), West Indian elm (*Guazuma ulmifolia*) and tepeguaje (*Lysiloma* sp.). Oak Forest vegetation covers 0.78% of the municipal area, represented by various oak species (*Quercus* spp.), encino napis (*Quercus magnoliifolia*), white pine (*Pinus douglasiana*), Mexican yellow pine (*P. ocarpa*). Grassland vegetation is 1.66% of the area with species such as muhly (*Muhlenbergia* sp.), bonete (*Jacaratia mexicana*), three-awns wiregrasses (*Aristida* spp.)

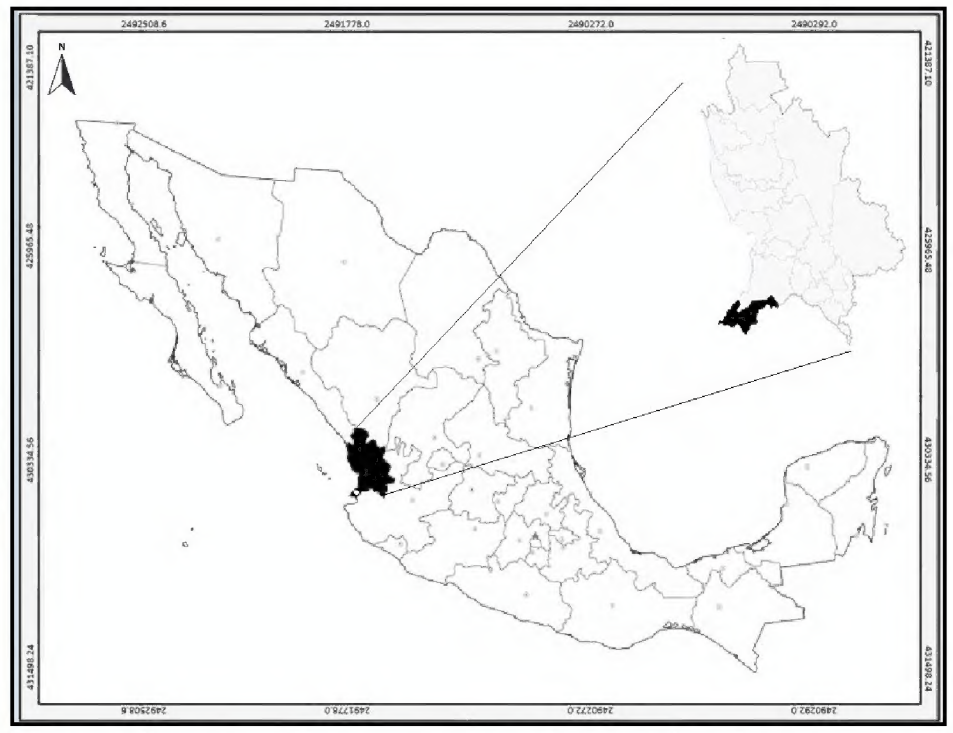

Figure 3. Location of the municipality of Bahía de Banderas in the Mexican state of Nayarit.

and grama grass (*Bouteloua* sp.). The agricultural area, where corn (*Zea mays*), beans (*Phaseolus vulgaris*), sesame (*Sesamun indicum*) and chilis (*Capsicum annuum*) are grown, is 24.41% of the municipal area. Urban area represents 3.98% of the municipal area (INEGI, 1999, 2010).

Materials and methods

Field work: From 2021 to 2023, our field work was focused on searching for areas where surveys could be conducted. Eighteen *ejido* communities were visited in the municipality, namely: Lo de Marco, Punta Monterrey, Higuera Blanca, San Francisco (San Pancho), Sayulita, Punta de Mita, Nuevo Nayarit, Cruz de Huanacaxtle, Bucerias, Jarretaderas, San Vicente, Mezcales, San José del Valle, Valle de Banderas, San Juan de Abajo, El Capomo, El Porvenir and Fortuna de Vallejo. All localities included some patches of natural vegetation. Our work consisted of sporadic sampling, following the methods of Jiménez-Velázquez et al. (2012). Daytime sampling was extensive, searching all susceptible areas for the presence of amphibians and reptiles, covering random sampling sites in transects, observing in streams, leaf litter, under logs, under rocks and including hollows. Night sampling consisted of driving in linear transects across paved roads that connect one *ejido* community to another, a method used by Klauber (1939). When a specimen was found, it was photographed *in situ* for identification and

Figure 4. Tropical Deciduous Forest located in San Francisco (San Pancho), Bahía de Banderas, Nayarit.

Figure 5. Medium Deciduous Forest in Sayulita, Bahía de Banderas, Nayarit.

Figure 6. Coastal Dunes in Punta de Mita, Bahía de Banderas, Nayarit.

then returned exactly where it was found. Abundance numbers, vegetation type where it was found, and conservation status were added to a database.

Desk work: We carried out a review of the literature and the online databases extracted from GBIF (2024) to strengthen the list obtained by our field sampling efforts. Then we included the species that were not observed in the field but were mentioned by other authors, taking into account the literature record or the databases of biological collections, as well as basic information about the vegetation of the communities present. Species affinity was detailed in terms of natural habitat use with eight vegetation types: LTS = Low Thorny Scrub; LDF = Tropical Deciduous Forest, MDF = Medium Deciduous Forest; RV = Riparian Vegetation; CD= Coastal Dunes, M = Mangroves; HV = Halophyte Vegetation; PG = Palm Grove. The species were identified as native, endemic to Mexico, and introduced. The conservation status was as follows: the status by the Official Mexican Standard SEMARNAT (2010-2019) and the IUCN Red List (2023) was included, we also included the evaluated environmental vulnerability score (EVS) by Wilson et al., (2013a; 2013b), so that species belonging to categories such as insufficient data, not assessed, and least concern according to the IUCN with EVS could be assessed with greater understanding. The taxonomic order was followed by Loc-Barragán et al. (2024).

Results

A total of 1494 organisms were recorded, belonging to 72 native species of amphibians and reptiles, representing 30 families and 58 genera, these include 19 species of amphibians (all

Figure 8. *Incilius marmoreus*, found in Medium Deciduous Forest at San Pancho, Bahía de Banderas, Nayarit.

Figure 7. Tropical Deciduous Forest and Coastal Dunes in Lo de Marco, Bahía de Banderas, Nayarit.

anurans) and 53 reptiles (a crocodile, 18 lizards, 26 snakes and 8 turtles). Of the 72 species, 13 amphibians and 31 reptiles are endemic to Mexico. Twenty-eight of the non-endemics are native to Mexico. And six introduced species are present: *Lepidodactylus lugubris, Scinax staufferi*, *Anolis sagrei, Gehyra mutilata, Hemidactylus frenatus,* and *Indotyphlops braminus*. The most represented amphibian family is Hylidae with seven species, and the most represented reptile family is Colubridae with 11 species. Regarding the conservation status of the species found, three amphibians and 25 reptiles are classified under Mexican environmental legislation (SEMARNAT, 2010-2019), 20 (three amphibians and 17 reptiles) are under "special protection" (Pr), 3 (reptiles) "Threatened" (A) and five "endangered" (P). According to the International Union for Conservation of Nature (IUCN, 2023), 14 of the amphibian and reptile species are in the "Not Assessed" (NE) category, one in the "Data Deficient" (DD) category, 47 in the "Least Concern" (LC) category, one in the "Near Threatened" (NT) category, four in the "Vulnerable" (VU) category, one in the "Endangered" category and two in the "Critically Endangered" (CR) category. Using the Environmental Vulnerability Score (EVS) proposed by Wilson et al., (2013a, b) to compare these categories; six amphibians and 13 reptiles fall into the low vulnerability (L) category, eight amphibians and 14 reptiles fall into the medium vulnerability category and three amphibians and 15 reptiles fall into the high vulnerability category. An EVS score was not evaluated for 12 of the recorded species (Table 1). With regard to vegetation communities, 11 species of amphibians and reptiles were observed in Low Thorny Scrub (LTS), 56 in Tropical Deciduous Forest (TDF), 32 in Medium Deciduous Forest (MDF), 11 in Riparian Vegetation (RV), nine in Coastal Dunes (CD), 15 in Mangrove (M), five in Halophyte Vegetation (HV) and four in Palm Grove (PG) (Tables 1 and 2).

Discussion and conclusions

Currently, the herpetofauna of Nayarit is home to 162 native species, 37 species of amphibians (35 anurans and two salamanders) and 125 reptiles (one crocodile, 45 lizards, 69 snakes and 11 turtles, representing 35 families (11 families of amphibians [nine anurans and two salamanders] and 24 families of reptiles [one crocodile, ten lizards, eight snakes and five turtles]) and 85 genera (20 amphibians and 65 reptiles). of which 102 are endemic to Mexico and two endemics to Nayarit (Loc-Barragán et

Figure 9. *Craugastor occidentalis*, found in Medium Deciduous Forest at Sayulita, Bahía de Banderas, Nayarit.

Figure 10. *Eleutherodactylus modestus*, found in Tropical Deciduous Forest at Cruz de Huanacaxtle, Bahía de Banderas, Nayarit.

Figure 11. *Basiliscus vittatus*, found in Tropical Deciduous Forest at Mezcales, Bahía de Banderas, Nayarit.

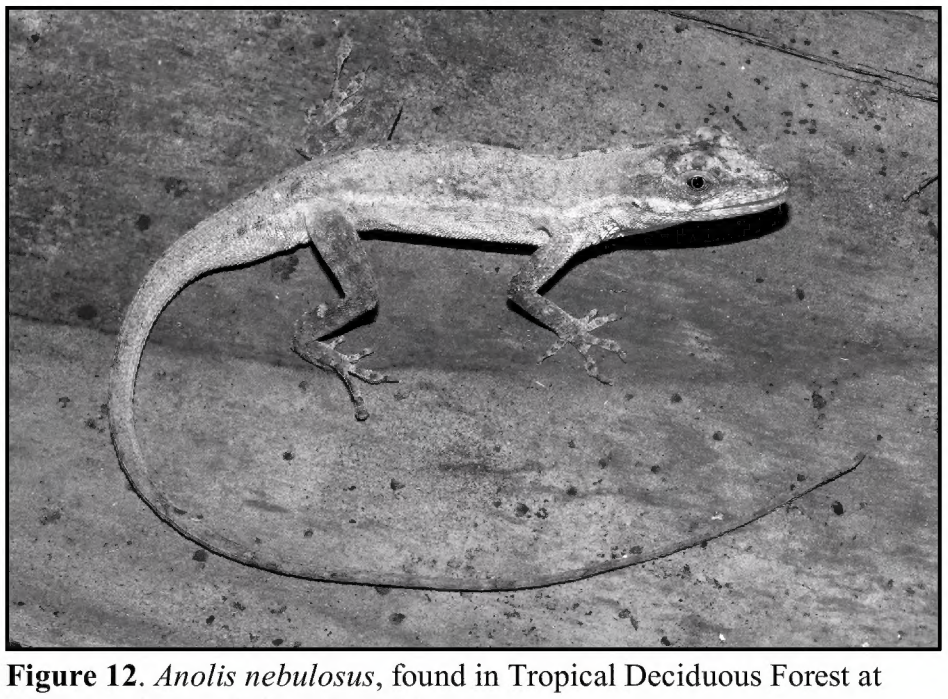

Figure 12. *Anolis nebulosus*, found in Tropical Deciduous Forest at Mezcales, Bahía de Banderas, Nayarit.

Figure 13. *Ctenosaura pectinata*, found in Tropical Deciduous Forest at San Pancho, Bahía de Banderas, Nayarit.

Figure 14. *Aspidoscelis lineattissimus*, found in Tropical Deciduous Forest at San Pancho, Bahía de Banderas, Nayarit.

al., 2024). The herpetofauna of Bahía de Bandera comprises 44.4% of the herpetofauna of Nayarit. In this paper, following the checklist of Loc-Barragán et al. (2024), *Phyllodactylus isabelae* was not included as a species, since it is now regarded as a subspecies of *P. lanei* (Uetz, 2024). Six of the eight species reported as introduced to Nayarit have been introduced into Bahía de Banderas (Loc-Barragán et al., 2024): *Lepidodactylus lugubris, Scinax staufferi, Anolis sagrei, Gehyra mutilata, Hemidactylus frenatus,* and *Indotyphlops braminus*.

Previous bibliographic records for the municipality of Bahía de Banderas consist of only two lists: One of reptiles found in the Laguna El Quelele, located in the *ejido* community of Mezcales (Fuentes-Castrejón and Maldonado-Gasca, 2015), and the amphibians and reptiles of the southern area of the Sierra de Vallejo, Bahía de Banderas (Miramontes, 2017) and reports of presence for the municipality of Bahía de Banderas (Ahumada-Carrillo et al., 2013; Rosales-Martínez et al., 2021). A search of online databases (GBIF, 2024) of preserved collections we found records of specimens from Bahía Bandera Bay that had not been published for 10 herpetological species. The sum of all this information makes a total of 72 species for this group that are now known to be present in the municipality of Bahía de Banderas. We also include a comparison of the results of this study with the published results for other municipalities in the state of Nayarit (Table 2). We would like to continue our surveys as the municipality is undergoing a rapid development, we need to document the effect of this development, especially in the road construction sector.

Acknowledgments

To Juan Marin for providing me with his *Marisora aquilonaria* record and being informed in this study. To David Lazcano for his selfless support, and to Mike Dloogatch for his comments and improvements to the manuscript.

Table 1. Distributional and conservation status of the amphibians and reptiles recorded from the municipality of Bahia de Banderas, Nayarit, Mexico. The numbers of specimens are listed according to the vegetation type in which they were collected. Nomenclature follows Wilson et al. (2013a, b). An asterisk (*) in front of the species name indicates a new record for the municipality. A dagger (†) in front of the species name indicates an introduced species. **END** = endemism: E = endemic to Mexico; N = not endemic to Mexico. **NOM** = protection status under NOM-ECOL-059-2010 (SEMARNAT, 2010-2019): P = En Peligro de Extinción (Endangered); A = Amenazada (threatened); Pr = Protección Especial (Special Protection); NS = No Status. **IUC** = IUCN categorization: CR =Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; LC = Least Concern; DD = Data Deficient; and NE = Not Evaluated. **EVS** = Environmental Vulnerability Score (*sensu* Wilson et al., 2013a, b): low (L) vulnerability species (EVS of 3–9); medium (M) vulnerability species (EVS of 10–13); and high (H) vulnerability species (EVS of 14–20). **Vegetation**: **LTS** = Low Thorny Scrub; **LDF** = Tropical Deciduous Forest, **MDF** = Medium Deciduous Forest; **RV** = Riparian Vegetation; **CD** = Coastal Dunes, **M** = Mangroves; **HV** = Halophyte Vegetation; **PG** = Palm Grove.

Species	Conservation status				Vegetation type							
	END	NOM	IUC	EVS	LTS	LDF	MDF	RV	CD	M	HV	PG
Class Amphibia												
Order Anura												
Family Bufonidae (1 genus, 3 species)												
Incilius marmoreus (Wiegmann, 1833)	E	NL	LC	M(11)		19	10					
I. mazatlanensis (Taylor, 1940)	E	NL	LC	M(12)		14	10					
Rhinella horribilis (Linnaeus, 1758)	N	NL	NE	L(3)		26	10					
Family Craugastoridae (1 genus, 4 species)												
Craugastor hobartsmithi (Taylor, 1936)	E	NL	LC	H(15)		2	2					
C. occidentalis (Taylor, 1941)	E	NL	LC	M(13)		6	20					
C. pygmaeus (Taylor, 1937)	N	NL	LC	L(9)		1	1					
C. vocalis (Taylor, 1940)	E	NL	LC	M(13)		1	1					
Family Eleutherodactylidae (1 genus, 3 species)												
Eleutherodactylus modestus (Taylor, 1942)	E	Pr	LC	H(16)		3						
E. jamesdixoni Devitt, Tseng et al., 2023	E	NL	NE	NE		5						
**E. pallidus* (Duellman, 1958)	E	Pr	LC	H(17)		25						
Family Hylidae (1 genus, 6 species)												
**Exerodonta smaragdina* (Taylor, 1940)	E	Pr	LC	M(12)			2					
†*Scinax staufferi* (Cope, 1865)	–	–	–	–	–	–	–	–	–	–	–	–
Smilisca baudinii (Duméril and Bibron, 1841)	N	NL	LC	L(3)		20	20	20		1		
**S. fodiens* (Boulenger, 1882)	N	NL	LC	L(8)		6						
Tlalocohyla smithii (Boulenger, 1902)	E	NL	LC	M(11)		11						
Trachycephalus vermiculatus (Cope, 1877)	N	NL	NE	L(4)		6						
Triprion spatulatus Günther, 1882	E	NL	LC	M(13)		1	1	1				
Family Leptodactylidae (1 genus, 1 species)												
Leptodactylus melanonotus (Hallowell, 1861)	N	NL	LC	L(6)		2	1					
Family Phyllomedusidae (1 genus, 1 species)												
Agalychnis dacnicolor (Cope, 1864)	E	NL	LC	M(13)		40	3					
Family Ranidae (1 genus, 1 species)												
Rana cora Pérez-Ramos & Luja Molina, 2022	E	NL	NE	NE		1		1				

Table 1 (cont'd).

Species	Conservation status				Vegetation type							
	END	**NOM**	**IUC**	**EVS**	**LTS**	**LDF**	**MDF**	**RV**	**CD**	**M**	**HV**	**PG**
Class Reptilia												
Order Crocodylia (1 Family)												
Family Crocodylidae (1 genus, 1 species)												
Crocodylus acutus Cuvier,1807	N	Pr	VU	H(14)				142	31	7		
Order Squamata												
Suborder Lacertilia (10 Family)												
Family Anguidae (1 genus, 1 species)												
Gerrhonotus liocephalus Wiegmann, 1828	N	Pr	LC	L(6)		2	2					
Family Corytophanidae (1 genus, 1 species)												
Basiliscus vittatus Wiegmann, 1828	N	NL	LC	L(7)				7				
Family Anolidae (1 genus, 2 species)												
Anolis nebulosus (Wiegmann, 1834)	E	NL	LC	M(13)	9	13	17	4	1	6	6	6
†*A. sagrei* Duméril & Bibron, 1837	–	–	–	–	–	–	–	–	–	–	–	–
Family Gekkonidae (3 genera, 3 species)												
†*Gehyra mutilata* (Wiegmann, 1834)	–	–	–	–	–	–	–	–	–	–	–	–
†*Hemidactylus frenatus* Duméril & Bibron, 1836	–	–	–	–	–	–	–	–	–	–	–	–
†*Lepidodactylus lugubris* (Duméril & Bibron, 1836)	–	–	–	–	–	–	–	–	–	–	–	–
Family Helodermatidae (1 genus, 1 species)												
Heloderma horridum (Wiegmann, 1829)	E	A	LC	M(11)	2	10						
Family Iguanidae (1 genus, 2 species)												
Ctenosaura pectinata (Wiegmann, 1834)	E	A	LC	H(15)	22	40	15		3	25		17
Iguana iguana (Linnaeus, 1758)	N	Pr	LC	M(12)	40	102	10	10		10		
Family Phrynosomatidae (2 genera, 5 species)												
Sceloporus albiventris Smith, 1939	E	NL	NE	H(16)		8						
S. clarkii Baird & Girard, 1852	N	NL	LC	M(10)			2					
S. melanorhinus Bocourt, 1876	N	NL	LC	L(9)	4	20	3			2		
S. utiformis Cope, 1864	E	NL	LC	H(15)	8	10	5			15		
Urosaurus bicarinatus (Duméril, 1856)	E	NL	LC	M(12)	13	8				5	1	
Family Phyllodactylidae (1 genus, 1 species)												
Phyllodactylus lanei Smith, 1935	E	NL	LC	H(15)		20						1
Family Scincidae (2 genera, 2 species)												
**Marisora aquilonaria* McCranie, Matthews et al., 2020	E	NL	NE	NE		1						
Plestiodon parvulus (Taylor, 1933)	E	NL	DD	H(15)		3						2
Family Teiidae (2 genera, 4 species)												
Aspidoscelis communis (Cope, 1978)	E	Pr	LC	H(14)			5			5	1	
A. costatus (Cope, 1878)	E	Pr	LC	M(11)						6	5	
A. lineattissimus (cope, 1878)	E	Pr	LC	H(14)	74	20	10		15	6		
Holcosus sinister (Wiegmann, 1834)	E	NL	NE	M(13)		1	1			1	1	
Order Squamata												
Suborder Serpientes (6 families)												
Family Boidae (1 genus, 1 species)												
Boa sigma Smith, 1943	E	NS	NE	H(15)	10	11	9			5		
Family Colubridae (11 genera, 11 species)												
Drymarchon melanurus (Duméril, Bibron & Duméril, 1854)	N	NS	LC	L(6)	2	8						
Drymobius margaritiferus (Schlegel, 1837)	N	NS	LC	L(6)		3	3					
Lampropeltis polyzona Cope, 1860	E	NS	LC	L(7)		4						
Leptophis diplotropis (Günther, 1872)	E	A	LC	H(14)	11	4	4			1		
Masticophis mentovarius (Duméril, Bibron & Duméril, 1854)	N	NS	NE	L(6)		4	3					
Mastigodryas melanolomus (Cope, 1868)	N	NS	LC	L(6)			1					
Oxybelis microphthalmus Barbour & Amaral, 1926	E	NS	NE	NE		14	4					
Salvadora mexicana (Duméril, Bibron & Duméril, 1854)	E	Pr	LC	H(15)		10						
Senticolis triaspis (Cope, 1866)	N	NS	LC	L(6)		3						
Tantilla calamarina Cope, 1866	E	Pr	LC	M(12)		2						
Trimorphodon paucimaculatus Taylor, 1938	E	NS	NE	H(15)		4						

Table 1 (cont'd).

Species	Conservation status				Vegetation type							
	END	**NOM**	**IUC**	**EVS**	**LTS**	**LDF**	**MDF**	**RV**	**CD**	**M**	**HV**	**PG**
Family Dipsadidae (7 genera, 8 species)												
Coniophanes lateritius Cope, 1862	E	NS	DD	M(13)		1	1					
Hypsiglena torquata (Günther, 1860)	E	Pr	LC	L(8)		17						
Imantodes gemmistratus (Cope, 1861)	N	Pr	LC	L(6)		6						
Leptodeira maculata (Hallowell, 1861)	E	Pr	LC	L(7)		17						
L. polysticta (Günther, 1895)	N	NS	NE	NE		7						
Manolepis putnami (Jan, 1863)	E	NS	LC	M(13)		9						
Rhadinaea hesperia Bailey, 1940	E	Pr	LC	M(10)		11						
Tropidodipsas philippii(Jan, 1863)	E	Pr	LC	H(14)		3						
Family Elapidae (2 genera, 2 species)												
Hydrophis platurus (Linnaeus, 1766)	N	NS	LC	NE					41			
Micrurus browni Schmidt & Smith, 1943	N	NS	NE	NE		3	3					
Family Natricidae (1 genus, 1 species)												
Thamnophis validus (Kennicott, 1860)	E	NS	LC	M(12)		3				3		
Family Typhlopidae (1 genus, 1 species)												
†*Indotyphlops braminus* (Daudin, 1803)	–	–	–	–	–	–	–	–	–	–	–	–
Family Viperidae (2 genera, 2 species)												
Agkistrodon bilineatus Günther, 1863	N	Pr	NT	M(11)		2		2				
Crotalus basiliscus (Cope, 1864)	E	Pr	LC	H(16)		5	7					
Order Testudines (5 families)												
Family Cheloniidae (3 genera, 3 species)												
Chelonia mydas (Linnaeus, 1758)	N	P	EN	NE					2			
Eretmochelys imbricata (Linnaeus, 1766)	N	P	CR	NE					2			
Lepidochelys olivacea (Eschscholtz, 1829)	N	P	VU	NE					10			
Family Dermochelyidae (1 genus, 1 species)												
Dermochelys coriacea (Vandelli, 1761)	N	P	VU	NE					1			
Family Emydidae (1 genus, 1 species)												
Trachemys ornata (Gray, 1831)	E	Pr	VU	H(19)				53				
Family Geoemydidae (1 genus, 1 species)												
Rhinoclemmys pulcherrima (Gray, 1855)	N	NS	NE	L(8)		4	3					
Family Kinosternidae (1 genus, 2 species)												
Kinosternon integrum LeConte, 1854	E	Pr	LC	M(11)				22				
K. vogti López-Luna, Cupul-Magaña et al., 2018	E	P	CR	NE				2				

Table 2. Composition of the herpetofauna reported for each of seven Nayarit municipalities. Vegetation communities: LTS = Low Thorny Scrub, LDF = Tropical Deciduous Forest, MDF = Medium Deciduous Forest, OF = Oak Forest, POF = Pine Oak Forest, PF = Pine Forest, CF = Cloud Forest, RV = Riparian Vegetation, CD = Coastal Dunes, M = Mangrove, HV = Halophyte Vegetation, PG = Palm Grove.

Municipality	Number of herpetofauna species for each vegetation community												Number of species reported	
	LTS	**TDF**	**MDF**	**OF**	**POF**	**PF**	**CF**	**RV**	**CD**	**M**	**HV**	**PG**	**Amph**	**Rept**
Tepic[1]	–	–	–	–	–	–	–	–	–	–	–	–	14	19
La Yesca [2]	–	–	–	–	–	–	–	–	–	–	–	–	7	18
Santiago[3]	18	12	19	–	–	–	–	14	–	–	–	–	10	23
Tecuala[4]	30	25	–	–	–	–	–	16	12	9	7	–	17	34
Compostela[5]	–	46	37	13	–	–	9	–	9	6	–	8	21	50
Huajicori[6]	–	45	–	2	3	4	–	–	–	–	–	–	20	37
Bahía de Banderas [7]	11	56	32	–	–	–	–	11	9	15	5	4	19	53

1. López-Solís and Luja (2014)
2. Caravantes Estrada et al. (2017)
3. Molina and Miramontes (2016)
4. Loc-Barragán and Lazcano (2018)
5. Loc-Barragán et al. (2018)
6. Loc-Barragán et al. (2019); Loc-Barragán (2019); Loc-Barragán and Woolrich-Piña (2020)
7. This study

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Appendix 1: Voucher Specimens Recorded and Deposited in Scientific Collections

Acronyms = **IBUNAM:** Instituto de Biología, Universidad Nacional Autónoma de México. **MZFC:** Museo de Zoología de la Facultad de Ciencias, Universidad Nacional Autónoma de México. **UTEP:** Collection of Herpetology, Laboratory of Environmental Biology, Biological Science Department, University of Texas – El Paso. USNM:
Incilius marmoreus*:** UTEP H-5509-5510. ***Incilius mazatlanensis: UTEP:H: 5867-5868-5867. *Craugastor occidentalis* MZFC23711-23712-23713 UTEP: Herp: 6616-6617-6618-6619-6620. ***Craugastor vocalis:*** UTEP:H:6621 UTEP: H:6631. ***Eleutherodactylus pallidus:*** IBUNAM-CNAR 5921. ***Tlalocohyla smithii:*** UTEP: Herp:6625; USNM 238002-238003-238004-238005-238007-238006-238008-238009-238010-238011-238012-238013-238014-238015. ***Smilisca Baudinii:*** MSUM HE.11973- HE.11974- HE.11975; IBUNAM CNAR 207. ***Leptodactylus melanonotus:*** USNM 238016. ***Agalychnis dacnicolor:*** USNM 238018-238019-238020-238021-238022. ***Rana cora***: USNM 238023-238024-238025. ***Kinosternon integrum***: USNM 238066-238066.

Appendix 2: Localities and Numbers of Specimens Recorded

***Incilius marmoreus* (29):** San Francisco (San Panchos); Sayulita; Cruz de Huanacaxtle; Bucerías; El Colomo.
***Incilius mazatlanensis* (24):** San Francisco (San Panchos); Higuera Blanca; Punta de Mita; Cruz de Huanacaxtle; Bucerías; Mezcales; San Vicente; El Colomo.
***Rhinella horribilis* (36):** San Francisco (San Panchos); Sayulita; Bucerías; Mezcales.
***Craugastor hobartsmithi* (4):** San Francisco (San Panchos).
***Craugastor occidentalis* (26):** San Francisco (San Panchos); Sayulita; Colomo (Sierra Vallejo).
***Craugastor pygmaeus* (2):** San Francisco (San Panchos); Bucerías.
***Craugastor vocalis* (2):** Sierra Vallejo.
***Eleutherodactylus modestus* (3):** San Francisco (San Panchos); Sayulita; Cruz de Huanacaxtle.
***Eleutherodactylus jamesdixoni* (5):** San Francisco (San Panchos)
***Eleutherodactylus pallidus* (25):** Lo de Marcos; San Francisco (San Panchos); Sayulita; Higuera Blanca; Punta de Mita; Cruz de Huanacaxtle; Bucerías; Nuevo Nayarit.
***Exerodonta smaragdina* (2):** San Francisco (San Panchos).
Scinax staufferi (5): Bucerias, Mezcales
***Smilisca baudinii* (61):** Lo de Marcos; San Francisco (San Panchos); Sayulita; Higuera Blanca; Punta de Mita; Cruz de Huanacaxtle; Bucerías; San Vicente; Nuevo Nayarit.
***Smilisca fodiens* (6):** Mezcales; San Juan de Abajo.
***Tlalocohyla smithii* (11):** Lo de Marcos; San Francisco (San Panchos); Punta de Mita; Mezcales; San Vicente.
***Trachycephalus vermiculatus* (6):** Punta de Mita; Cruz de Huanacaxtle; Bucerías; Nuevo Nayarit; San Vicente.
***Triprion spatulatus* (3):** Sayulita.
***Leptodactylus melanonotus* (3):** San Juan de Abajo; Valle de Banderas; Mezcales.
***Agalychnis dacnicolor* (43):** San Francisco (San Panchos); Higuera Blanca; Punta de Mita; Cruz de Huanacaxtle; Bucerías; Mezcales; San Vicente; San José del Valle.
***Rana cora* (2):** Lo de Marcos; Mezcales.
***Crocodylus acutus* (180):**San Francisco (San Pancho); Punta de Mita; Cruz de Huanacaxtle; Bucerías; Mezcales; Nuevo Nayarit; Jarretaderas; San Vicente.
***Gerrhonotus liocephalus* (4):** San Francisco (San Pancho); Sayulita; Higuera Blanca; Punta de Mita.
***Basiliscus vittatus* (7):** Lo de Marcos; San Francisco (San Pancho); Nuevo Nayarit; San José del Valle.
***Anolis nebulosus* (62):** Lo de Marco; Punta Monterrey; San Francisco (San Pancho); Sayulita; Higuera Blanca; Punta de Mita; Cruz de Huanacaxtle; Bucerías; Nuevo Nayarit; Jarretaderas; San Vicente; San José del Valle; Valle de Banderas.
***Gehyra mutilata* (IN):** Lo de Marcos; Francisco (San Pancho); Sayulita; Punta de Mita; Cruz de Huanacaxtle; Bucerías; Nuevo Nayarit; Mezcales; Jarretaderas.
***Heloderma horridum* (12):** San Francisco (San Pancho); Sayulita.

***Ctenosaura pectinata* (122):** Lo de Marco; Punta Monterrey; San Francisco (San Pancho); Sayulita; Higuera Blanca; Punta de Mita; Cruz de Huanacaxtle; Bucerías; Nuevo Nayarit; Jarretaderas; San Vicente; San José del Valle; San Juan de Abajo.
***Iguana iguana* (172):** Lo de Marco; San Francisco (San Pancho); Sayulita; Higuera Blanca; Punta de Mita; Cruz de Huanacaxtle; Bucerías; Nuevo Nayarit; Jarretaderas; San Vicente; San José del Valle; San Juan de Abajo.
***Sceloporus albiventris* (8):** Mezcales; San Vicente
***Sceloporus clarkii* (2):** San Ignacio
***Sceloporus melanorhinus* (29):** Lo de Marco; San Francisco (San Pacho); Sayulita.
***Sceloporus utiformis* (38):** San Francisco (San Pancho); Higuera Blanca; Cruz de Huanacaxtle; Mezcales; San Vicente; San José del Valle.
***Urosaurus bicarinatus* (27)**Cruz de Huanacaxtle; Bucerías.
***Phyllodactylus lanei* (21):** Lo de Marco; San Francisco (San Pacho); Sayulita; Punta de Mita; Cruz de Huanacaxtle; Bucerías; Mezcales.
***Marisora aquilonaria* (1):** Punta de Mita
***Plestiodon parvulus* (5):** Lo de Marco; San Francisco (San Pacho).
***Aspidoscelis communis* (11):** San Francisco (San Pancho); Punta de Mita.
***Aspidoscelis costatus* (11):** Sayulita; Bucerías; San Vicente; Nuevo Nayarit
***Aspidoscelis lineattissimus* (125):** Lo de Marco; Punta Monterrey; San Francisco (San Pancho); Sayulita; Higuera Blanca; Punta de Mita; Cruz de Huanacaxtle; Bucerías; Nuevo Nayarit; Jarretaderas; San Vicente; San José del Valle; Valle de Banderas.
***Holcosus sinister* (4):** Higuera Blanca; Bucerías; Fortuna de Vallejo.
***Boa sigma* (35):** San Francisco (San Pancho); Sayulita; Higuera Blanca; Punta Mita; Cruz de Huanacaxtle; San Vicente; Nuevo Nayarit; San Juan de Abajo.
***Drymarchon melanurus* (10):** San Francisco (San Pancho); Sayulita; Punta Mita; Bucerías; Mezcales; Nuevo Nayarit.
***Drymobius margaritiferus* (6):** San Pancho; Sayulita; Punta Mita.
***Lampropeltis polyzona* (4):** San Francisco (San Pancho); Sayulita; Nuevo Nayarit.
***Leptophis diplotropis* (20):** San Francisco (San Pancho); Sayulita; Higuera Blanca; Nuevo Nayarit; Cruz de Huanacaxtle; Mezcales; Nuevo Nayarit; San Vicente.
***Masticophis mentovarius* (7):** Sayulita; Punta de Mita; Cruz de Huanacaxtle; Bucerías; Nuevo Nayarit.
***Mastigodryas melanolomus* (1):** Cruz de Huanacaxtle.
***Oxybelis microphthalmus* (18):** San Francisco (San Pancho); Sayulita; Higuera Blanca; Punta Mita; Cruz de Huanacaxtle; Bucerías.
***Salvadora mexicana* (10):** San Francisco (San Pancho); Sayulita; Higuera Blanca; Punta Mita; Cruz de Huanacaxtle; El Guamúchil.
***Senticolis triaspis* (3):** San Francisco (San Pancho); Sayulita.
***Tantilla calamarina* (2):** Higuera Blanca.
***Trimorphodon paucimaculatus* (4):** San Francisco (San Pancho); Sayulita; San Ignacio.
Coniophanes lateritius (2): San Francisco (San Pancho)
***Hypsiglena torquata* (17):** San Francisco (San Pancho); Sayulita; Cruz de Huanacaxtle; Bucerías; Nuevo Nayarit; Mezcales; San Vicente; San José del Valle.
***Imantodes gemmistratus* (6):** San Francisco (San Pancho); Punta de Mita; Cruz de Huanacaxtle; Nuevo Nayarit.
***Leptodeira maculata* (17):** San Francisco (San Pancho); San Ignacio; Punta de Mita; Cruz de Huanacaxtle; Nuevo Nayarit.
***Leptodeira polysticta* (7):** Lo de Marco; San Francisco (San Pancho); Sayulita; Cruz de Huanacaxtle; Nuevo Nayarit.
***Manolepis putnami* (9):** Higuera Blanca; El Guamúchil; Cruz de Huanacaxtle; Bucerías.
***Rhadinaea hesperia* (11):** San Francisco (San pancho); Sayulita; Higuera Blanca; Cruz de Huanacaxtle.
***Tropidodipsas philippii* (3):** Francisco (San pancho); Sayulita.
***Hydrophis platurus* (41):** Lo de Marcos; San Francisco (San pancho); Sayulita; Higuera Blanca; Punta de Mita; Cruz de Huanacaxtle; Bucerias; Nuevo Nayarit.
***Micrurus browni* (6):** Lo de Marcos; Sayulita; Cruz de Huanacaxtle; Bucerias.
***Thamnophis validus* (6):** Mezcales; Nuevo Nayarit.
***Indotyphlops braminus* (2):** San Francisco (San Pancho); Bucerias.
***Agkistrodon bilineatus* (4):** Sayulita; San Jose del Valle.
***Crotalus basiliscus* (12):** San Francisco (San Pancho); Sayulita; Cruz de Huanacaxtle; Bucerias; San Juan de Abajo.
***Chelonia mydas* (2):** Cruz de Huanacaxtle
***Eretmochelys imbricata* (2):** Punta de Mita
***Lepidochelys olivacea* (10):** Lo de Marcos; San Francisco (San Pancho); Sayulita; Higuera Blanca; Punta Mita; Cruz de Huanacaxtle; Bucerias; Nuevo Nayarit.
***Dermochelys coriacea* (1):** Nuevo Nayarit.
***Trachemys ornata* (53):** Lo de Marco; Sayulita; Punta de Mita; Cruz de Huanacaxtle; Bucerias; Mezcales; San Vicente; El Porvenir; Nuevo Nayarit; San Jose del Valle; Valle de Banderas.
***Rhinoclemmys pulcherrima* (7):** Higuera Blanca; Bucerias; San Juan de Abajo.
***Kinosternon integrum* (22):** Mezcales; Valle de Banderas
***Kinosternon vogti* (2):** Not available

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A Brief Description of Newly Hatched *Eurycea longicauda* Larvae (Plethodontidae)

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Introduction

During a long term study (1975–2010) of the larval periods of the salamander genus *Eurycea* in southern Illinois I collected larvae with yolk remnants, undifferentiated limbs and other external, newly-hatched characters of *Eurycea longicauda*. This paper describes those larvae.

Morphotypes of anuran tadpoles have been well described (e.g., Altig and Johnston, 1989). However, descriptions of salamander larvae are few, with Valentine and Dennis (1964) being the most quoted but considered quite out of date. Other salamander larvae descriptions include: Brandon (1961); Valentine (1989); McDowell and Shinozaki (2015). Anderson and Martino (1966) described larval *E. longicauda* from temporary ponds in New Jersey at various stages of development but without a description of recent hatchlings (those with yolk remnants). The descriptions herein are derived from examination of the photographs shown in Figures 1–5, with certain traits depicting recent hatching characters. Other photographs were also used in the descriptions.

Materials and Methods

Larvae were collected in southern Illinois at two sites to initially determine larval life history. The localities sampled include two populations (both rocky streams) in Pope County, Illinois—one located 11 km north of Glendale, and the other 3 km east of Rosebud. A small aquarium dip net was used in capture of the larvae which were immediately preserved in 10% buffered formalin. Snout–vent lengths (SVLs) were measured with a metric ruler to the nearest mm. A Nikon stereo microscope (0–80×) and magnifying glass (10×) were used to further elucidate features of the larvae from photographs taken with a Nikon 35mm camera after several years preservation. Larvae are deposited at INHS (Illinois Natural History Survey, Champagne, Illinois) but have not yet been assigned catalogue numbers.

Results and Discussion

Eurycea longicauda—Table 1 shows details on number of larvae collected and dates of collection. The larvae are stream form (*sensu* Valentine and Dennis, 1964). Overall body color-

Figure 1.

Figure 2.

Figure 3.

Figure 4.

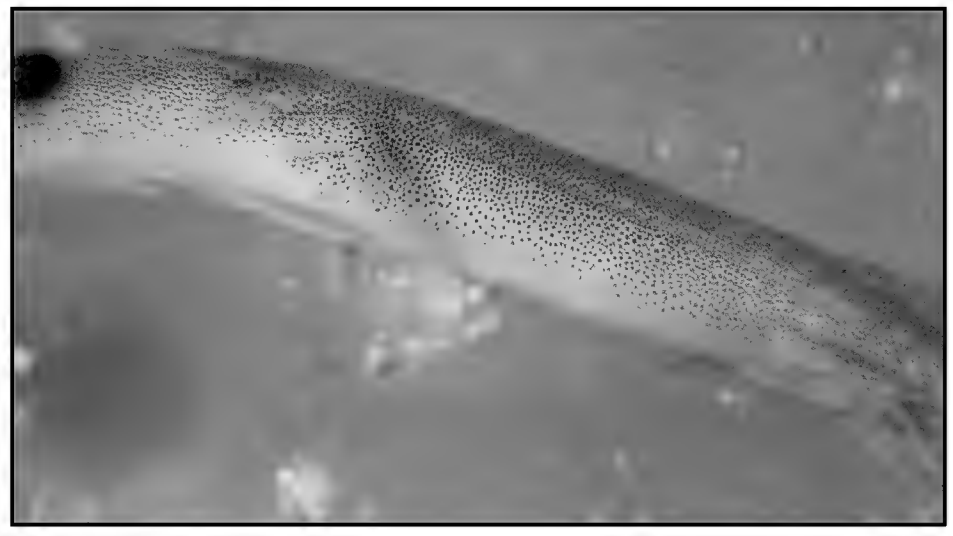

Figure 5.

Table 1. Collecting sites, dates and numbers of *Eurycea longicauda* larvae collected.

Collecting site	Date collected	Number collected
Pope County A	3/19/77	4
Pope County B	3/13/82 3/29/82 4/16/82	41

ation is somewhat dark. Melanophores and some mottling are present dorsally but lacking ventrally and laterally. They have four slender, tapering toes on each foot. The gills (three pairs) consist primarily of three medium-length fiber-like extensions; fimbriae were not discernible. Varying amounts of yolk are present ventrally from slightly anterior to the front legs to the region of the hind legs. The larvae are Harrison stage 57 or 58 and 9–11 mm SVL. The gular fold curves somewhat inward medially and is prominent. Tail fins extend both dorsally and ventrally from the hind legs to the tip of the tail. They lack balancers. Eyes are circular and darkly pigmented.

Acknowledgments

I greatly appreciate Gail F. Johnston for taking prints of the *Eurycea longicauda* larvae. For assistance in the field I thank Hiroko Ohtsu and especially Todd Boatright. Since the collections were made on private land, permits were not required. I did obtain permission from the landowners.

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Minutes of the CHS Board Meeting, April 16, 2024

A virtual meeting of the CHS board of directors via Zoom conference video/call was called to order at 7:30 P.M. Board members Kyle Houlihan, Caitlin Monesmith and Amelia Pollock were absent. Others in attendance besides board members were Dan Alexander, Ali Baghdadi, Robert Hansen and John Webb. Minutes of the March 14 board meeting were read and accepted.

Officers' Reports

Treasurer: Rich Crowley read through the financial report. Dan Alexander asked if the CHS has a formal budget. Mike Dloogatch replied that at several periods in our history we attempted to maintain a budget, but such attempts were never sustained. There was discussion of what might be possible if we could raise sufficient donations.

Vice-president: Amelia Pollock reported via email that the July meeting will include a virtual presentation from the Creature Conservancy in Ann Arbor, Michigan. At the August meeting Caitlin Monesmith will speak about the CHS Junior Herper program.

Media secretary: Gabby Evans is looking for assistance in the checking, monitoring, and posting of material for our social media platforms; it is too much for one person.

Membership secretary: Mike Dloogatch reported that membership is holding steady at just over 250.

Sergeant-at-arms: Tom Mikosz reported 27 attendees at the March 17 general meeting.

Committee Reports

Shows: Gail Oomens has scheduled a show at the Beaubien Woods Celebration, Saturday, June 8, 11 A.M. – 3 P.M. The CHS will also be present July 13–14 at the St. Andrews Greek Fest, 5649 N. Sheridan Road, in Chicago.

The meeting adjourned at 9:34 P.M.

Respectfully submitted by Gail Oomens

Herpetology 2024

In this column the editorial staff presents short abstracts of herpetological articles we have found of interest. This is not an attempt to summarize all of the research papers being published; it is an attempt to increase the reader's awareness of what herpetologists have been doing and publishing. The editor assumes full responsibility for any errors or misleading statements.

OCCURRENCE OF A LOCALLY RARE SNAKE

S. D. Snyder et al. [2023, Herpetologica 79(2):98-107] note that habitat management and species conservation plans are increasingly important as biodiversity losses increase. For many species, we lack the necessary data to implement habitat management or conservation plans because the species may be rare or difficult to detect, particularly at the periphery of geographic ranges. This may be especially true for snakes. For example, pygmy rattlesnakes (*Sistrurus miliarius*) have state-level protection at the northern terminus of the range but what little is known about the species in this region is derived from just 30 observations collected over the past 40 yr. This leaves considerable uncertainty regarding conservation status and establishes a need to better understand habitat suitability and their geographic distribution. Therefore, the objectives of this study were to determine landscape-scale environmental variables that influence patterns of distribution for *S. miliarius* in the northern extent of its range via the Maxent Species Distribution Algorithm coupled with on-site monitoring via standardized road-cruising transects (n = 43) to evaluate model suitability. The resulting species distribution model showed that suitable habitat (~2045.96 km^2) was composed primarily of riparian areas that exist in isolated patches. These habitats were primarily composed of sandy soils and low-elevation forested areas. On-site monitoring, informed by the modeling efforts, resulted in 12 new records for the species (an increase of 28.57%). Collectively, the authors' species distribution model suggests that suitable habitat for *S. miliarius* within their study area is restricted to riverine or riparian habitats associated with the Lower Tennessee River Valley. The methods used in this study employ a strategy to better understand suitable habitat for rare or secretive species that occur across large geographic areas.

MATING BEHAVIOR OF EASTERN HELLBENDERS

R. S. M. O'Brien et al. [2024, Herpetologica 80(1):1-10] note that eastern hellbenders (*Cryptobranchus alleganiensis alleganiensis*) are giant, charismatic salamanders of conservation concern. Despite growing interest in their breeding behavior, significant gaps remain in understanding hellbender reproduction, particularly the behavior occurring immediately prior to and during breeding because these activities typically occur within the nesting cavity and out of view. In this study, the authors used custom-built infrared cameras installed underwater in artificial nesting shelters to record prebreeding behaviors, complete mating sequences, and failed mating attempts in 11 shelters. Based on these recordings, they describe the basic mating sequence, the presence of potential alternative mating tactics, and two novel behaviors, including possible signal production via wave-based communication and unique egg laying behavior by female hellbenders. These findings add to our understanding of hellbenders' life history as well as informing conservation efforts in both captive and wild environments.

LONG-TERM SPOTTED SALAMANDER DECLINE

L. S. Billet et al. [2024, Herpetologica 80(1):11-21] note that worldwide, amphibians are experiencing high rates of decline. Large-scale, long-term studies of amphibians are crucial for uncovering potential causes of the declines; however, such long-term studies remain rare, particularly for salamanders. In this study, the authors monitored populations of spotted salamanders (*Ambystoma maculatum*) in 90 Connecticut ponds. Populations were divided between an inland, undeveloped landscape monitored for up to 23 yr and a coastal, developed landscape monitored for up to 9 yr. They measured the density of egg masses (number of egg masses per unit of search effort) each year at each pond for a total of 1392 pond-years of sampling effort and asked how egg mass densities and breeding probability relate to local environmental and climatic conditions. In the undeveloped landscape, average egg mass densities have declined by ~30% over the course of 2 decades. The presence of salamander breeding activity was positively associated with spring pond depth, and pond depth itself has declined by ~20% during the survey period. Egg mass density was related to road proximity and developed land cover: egg mass densities tended to be higher in ponds near roads and in ponds with less development within a 200-m buffer. In the developed landscape, egg mass densities showed a nonsignificant declining trend from 2014 to 2022 and salamander breeding activity was positively associated with higher canopy cover and larger pond surface area. These findings suggest that even in a protected landscape with increasing forest cover, spotted salamander egg mass densities are declining at a rate of 1.6%/yr. Decreasing pond depths are likely linked to decreased water yield as forests grow, which could affect pond hydroperiods (aquatic larval habitat) as well as forest soil moisture levels (adult habitat). Overall, increasing development may continue to negatively affect habitat of spotted salamanders and it is possible that forest maturation also has a negative influence on salamanders—an effect not documented previously.

GROWTH RATES OF INDIGO SNAKES

H. C. Chandler et al. [2023, Herpetologica 79(4):220-230] note thst introduction of species at sites where populations have been extirpated has become a common technique in wildlife conservation. To track progress towards reintroduction success, effective postrelease monitoring is needed to document vital rates of individuals and the corresponding impact on population trajectories. The authors assessed growth and body size in Eastern Indigo Snakes (*Drymarchon couperi*) using a data set from multiple projects across the species' distribution, including free-ranging wild snakes, snakes reared in captive-breeding programs, and snakes released at two reintroduction sites. They used these data to fit a von Bertalanffy growth model in a Bayesian framework to quantify differences in growth among three broad categories of snakes (wild, captive, and reintro-

duced), while accounting for measurement error across various projects. They also compared changes in body mass of captive-born individuals from four captive rearing facilities. Asymptotic snout–vent length across all groups was 185 cm (95% credible interval = 177–194 cm) for males and 157 cm (95% credible interval = 153–161 cm) for females. Reintroduced snakes had a higher growth coefficient than either captive or wild snakes (e.g., captive females = 1.20 [1.06–1.35] d^{-1}; wild females = 1.22 [0.95–1.49] d^{-1}; reintroduced females = 1.62 [1.21–2.05] d^{-1}), indicating that current captive-breeding and rearing efforts for indigo snakes produce similar or faster growth trends compared to wild populations. Furthermore, daily changes in juvenile body weight relative to body size were similar in three of the four captive rearing facilities (mean for females at Orianne Center for Indigo Conservation = 0.57 [0.48–0.65]; Zoo Atlanta = 0.55 [0.37–0.72]; Welaka National Fish Hatchery = 0.55, [0.36–0.73]; Auburn University = 0.39 [0.21–0.58]). Long-term project success for indigo snake reintroductions will depend on continuing to implement best practices in an adaptive management framework.

MATING TIMING FOR ORNATE BOX TURTLES

D. F. Hughes et al. [2023, Journal of Herpetology 57(2):246-253] note that many organisms respond to environmental change by altering the timing of various life-cycle events. Understanding an organism's phenology, therefore, is crucial for predicting the effects of anthropogenic impacts such as climate change. Nevertheless, collecting adequate data to test hypotheses in secretive species is difficult, especially for rare behaviors. The authors integrated data from online citizen science platforms, published literature, and unpublished studies to clarify the seasonal timing of copulation in *Terrapene ornata*, a behavior that is rarely observed. They identified 132 copulation events involving an estimated 256 individual turtles: 19 instances from 5,465 photo-vouchered observations, 78 from 11 publications, and 35 from radiotracking 267 turtles for 8 yr across five sites. Copulations in *T. ornata* occurred in every month from April to October, with the fewest records in April and October. No copulation records were found in two months of purported aboveground activity (March and November), suggesting that mating in the wild may not occur at all times during the active season. The frequency of reproductive events exhibited evident peaks in May and September. Records from the northern portion of the species' range were most frequent in the spring, whereas southern records were most frequent in the fall. This approach generated a large number of empirical records for a rare behavior in a secretive species across vast spatial scales, which would not have been possible using any of the individual data sources alone.

BOX TURTLE THERMAL ECOLOGY

G. L. Yerdon et al. [2023, Journal of Herpetology 57(1):92-98] note that prairie habitat loss in the United States has led to population declines in many prairie-associated species, including ornate box turtles (*Terrapene ornata*). Northwest Arkansas is an intergrade zone between the prairie-dwelling *T. ornata* and the more forest-associated three-toed box turtle (*Terrapene carolina*). As such, limited information exists on the potential differences in physiology and thermal ecology between the two box turtle species and how those differences might influence their habitat use. The authors addressed gaps in knowledge of the thermal and spatial ecology of *T. ornata* and *T. carolina* with a three-part study. First, they compared the thermal profiles of refugia, open, and vegetated microhabitats across degraded prairie, restored prairie, and adjacent forest macrohabitats using operative temperature models and a linear mixed effect model. Second, they measured total evaporative water loss of both species across a range of body sizes. Finally, they fitted a subset of turtles with iButton data loggers and monitored them in the field to examine carapace temperatures and habitat use. Operative temperature models recorded high, largely homogeneous temperatures across microhabitats in degraded prairie and heterogeneous temperatures across restored prairie microhabitats, while forest habitat maintained stable, cool temperatures. Both species exhibited similar evaporative water loss rates; however, *T. ornata* experienced a broader range of temperatures in the field. *Terrapene ornata* were exclusively found in prairie habitat, whereas *T. carolina* was often found in forested habitats and subsurface refugia. The results demonstrate key differences in box turtle thermal biology and highlight suboptimal thermal characteristics in degraded prairie and forest habitat that should be considered in prairie restoration and management for *T. ornata* conservation.

GRAY TREEFROGS IN THE CANOPY

E. R. Olson et al. [2023, Journal of Herpetology 57(3):281-289] note that the ecology of many arboreal ectotherms is poorly understood because of access constraints to the forest canopy. For example, despite their common name, gray treefrogs (*Hyla versicolor*) are understudied in arboreal habitats. Advancements in camera trap technology and tree-climbing techniques have created new opportunities to study arboreal species. Using arboreal camera trapping and time-lapse photography, the authors implemented the first study of *H. versicolor* behavior in the canopy. They examined seasonal and diel patterns of activity, microhabitat use, and effects of relative humidity and temperature on *H. versicolor* activity in eastern white pine (*Pinus strobus*) canopies. They installed camera traps at three research sites in northern Wisconsin, USA, spanning a 57-km north–south transect, and maintained them for multiple years. They detected *H. versicolor* events, of all sex–age classes, at two of our research sites. Use of time-lapse photography significantly improved the ability to detect *H. versicolor* in the canopy. *Hyla versicolor* individuals were active in the canopy every year of the study (2015–18), but predominantly during the summer, and peak diel activity occurred predominantly at night (between 2100 and 2300 h). *Hyla versicolor* activity significantly increased as relative humidity and temperature increased. *Hyla versicolor* individuals were significantly more active in the upper canopy compared with other canopy locations and selected for the top side of branches. Our results highlight that *H. versicolor* frequent arboreal habitats of *P. strobus* canopies. Although further research is needed, our work lays a foundation of *H. versicolor* ecology within the canopy. This research also demonstrates the feasibility of using arboreal camera traps with time-lapse settings to study ectotherms in forest canopies.

Bulletin of the Chicago Herpetological Society 59(5):79-80, 2024

Herpetological Art at the Fort Wayne Children's Zoo, Fort Wayne, Indiana—June 2023

Photos and story by
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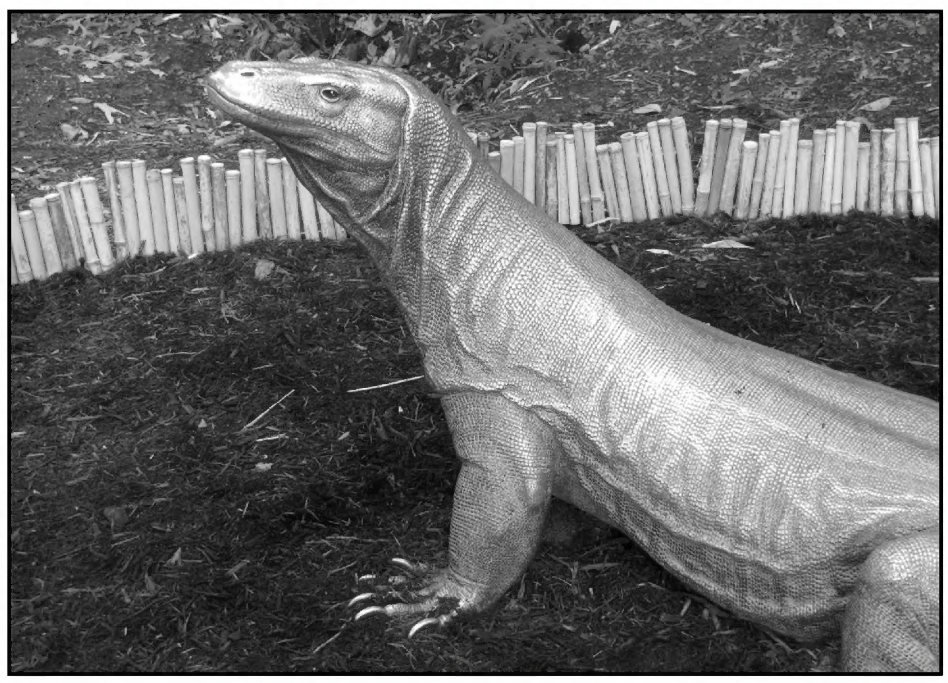
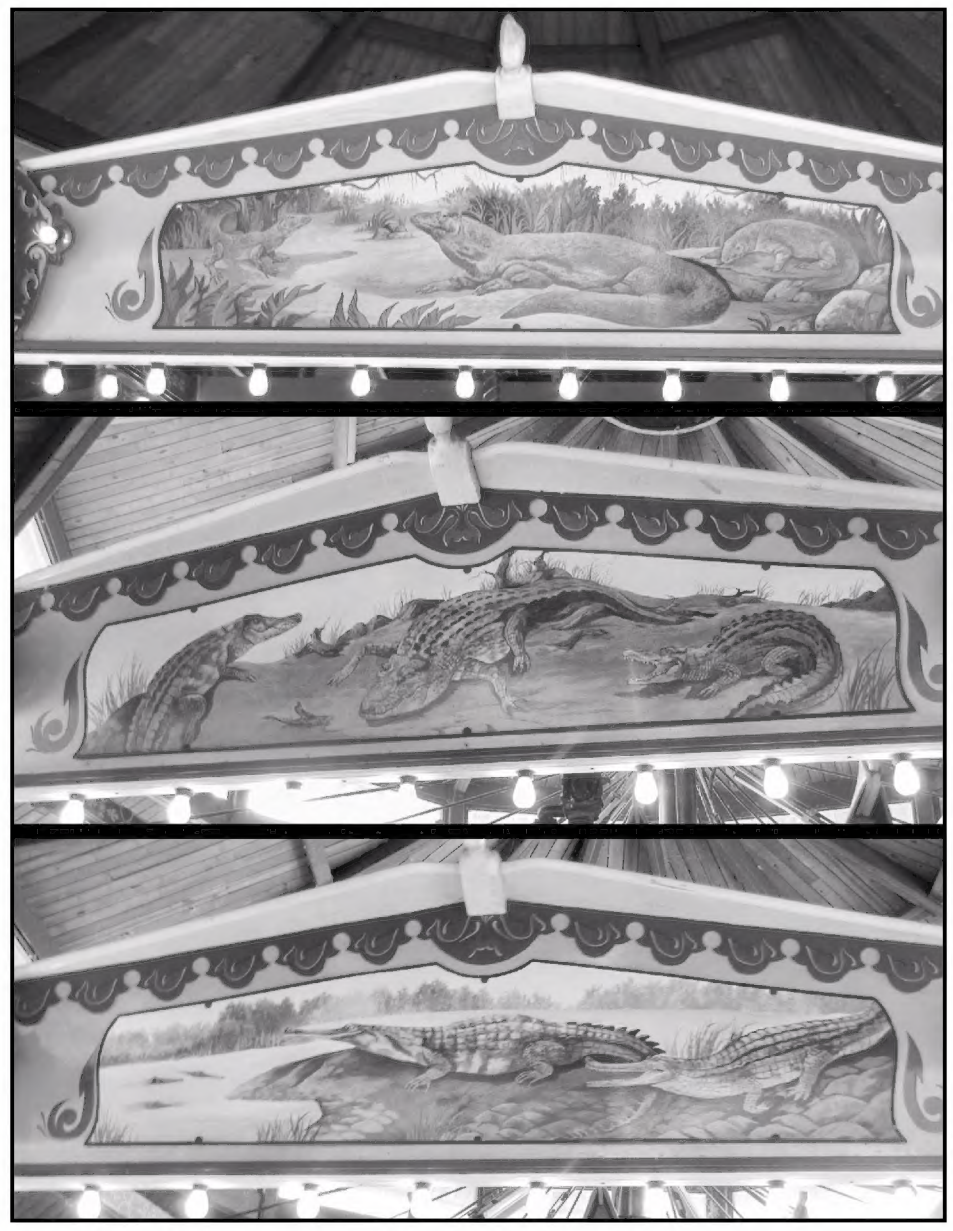
The Fort Wayne Children's Zoo (www.kidszoo.org) in Fort Wayne, Indiana, is in the northeast corner of the state. The zoo maintains roughly a thousand animals on 40 acres in Fort Wayne's Franke Park. The zoo map breaks the zoo down into zones: African Journey, Asian Trek, Australian Adventure and Central Zoo.

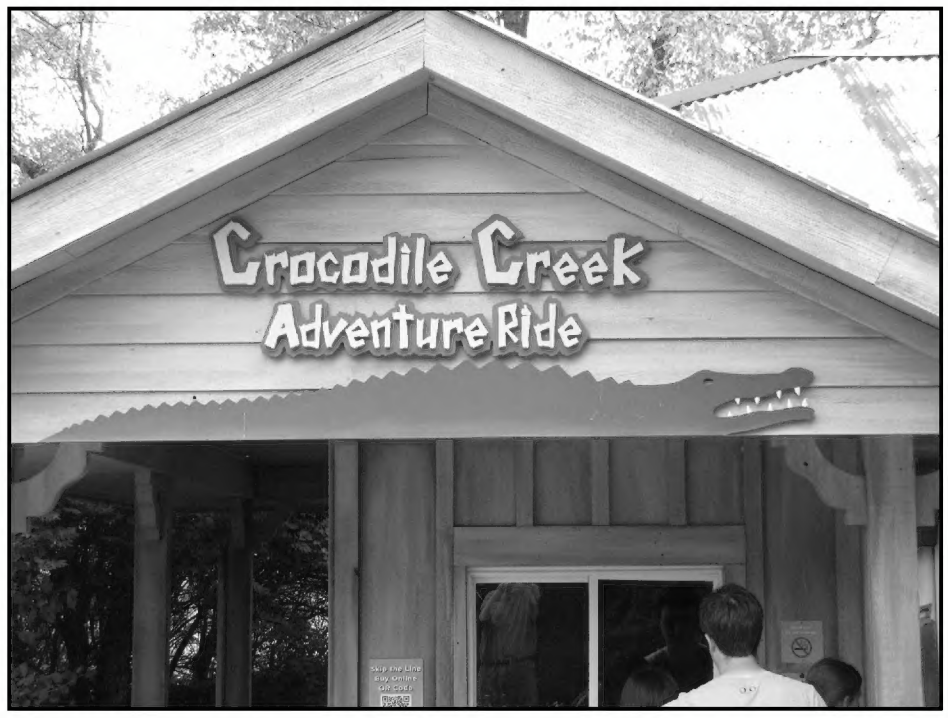
The first herpetological statue that we saw was a bronze Komodo dragon which is the size of an adult Komodo dragon, *Varanus komodoensis*. There weren't any signs to identify what animal this statue represents. Would the public maybe think this is a crocodile of some kind? This statue is just off the trail in the Indonesian rain forest, which is located in the Asian Trek zone.



Also, in the Asian Trek is a carousel with the usual animal rides you'd expect to see in a zoo carousel (tigers, giraffes, a panda, etc.) but no herps that can be ridden. However, at the top of the carousel are pictures showing scenes of many different animals in the wild. These include what I think might be three Komodo dragons, three American alligators, *Alligator mississippiensis*, and based on the slender snouts, gharials, *Gavialis gangeticus*, two in the foreground and in the background three others in the water.



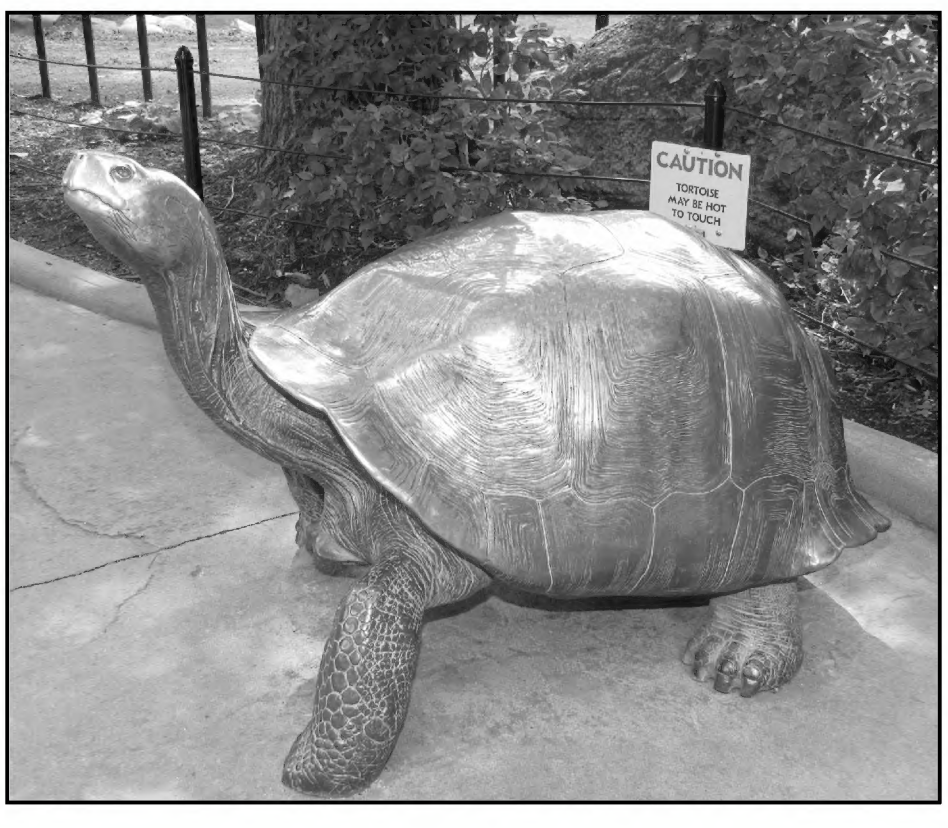
The Australian Adventure includes a water ride that circles an area called Outback Springs. Riders climb into a "dugout" that is made to look like a hollowed-out log. At the ticket booth is a sign that reads "Crocodile Creek Adventure Ride" with a cutout image of a crocodilian that looks like it might be at least 15 feet long. We saw some people on the ride and it looked like they might get wet. Also, in Outback Springs there is a concrete splash zone, maybe two city blocks long, that is made to look like a small creek with rounded rocks embedded in the concrete, flowing water that is probably a couple of inches deep, a bronze statue of a turtle, maybe 13 inches long, and might represent a



map turtle, *Graptemys*, because of the saw-like ridges on its back, and the bronze statue of a frog, maybe seven inches long. I searched through my Australian field guides and other books, and, from these statues, I can't identify any real turtle or frog that might be from Australia. There are displays of several live Australian animals that include a woma python, *Aspidites ramsayi*, a knob-tailed gecko, *Nephrurus* sp., and others. Either this turtle and frog are generic representatives of the animals that are found in Australia or someone could have gone into a little more effort to show a real Australian turtle and frog. Barefoot children were laughing and giggling as they splashed through the shallow creek.

In the Central Zoo zone, close to a large pond and the Hoffman's two-toed sloth display, there is a green plastic or fiberglass frog approximately two feet long. There is a button near its chest that you can push to play a recorded message that talks about conservation efforts.

In the Central Zoo zone, near the Indiana Family Farm at the Aldabra Tortoise pen (the tortoise was not on display at this time) is a bronze statue of what I think looks like a Galapagos tortoise. I showed this photograph around and the consensus is that this statue is a Galapagos tortoise—not an Aldabra tortoise. From the zoo's web site, I found the Contact link and sent an e-mail asking about this statue and the following is part of their reply: "The common method of identifying an Aldabra tortoise is to look for the presence of the nuchal scute, which is generally present above the neck. The Galapagos tortoise lacks a nuchal scute and has a more rounded head. The scutes are the "scales" on the shell of the tortoise and different species have different patterns, amounts, textures, colorings, etc. Although the presence of a nuchal scute tends to indicate that a giant tortoise is an Aldabra tortoise, not all Aldabra tortoises have them. . . our giant tortoise statue does not have a nuchal scute. This could point to it actually being the statue of a Galapagos tortoise due to the lack of a nuchal scute, as you may have deduced, or an Aldabra tortoise without a nuchal scute." This statue is the size of a large adult tortoise, and, behind it, there is a sign that says, "Caution Tortoise May Be Hot to Touch." I've seen this before in other zoos if a statue is sitting in the sun on hot summer days, but this statue is in the shade of a nice large tree so I don't know how much sun it can receive.



UPCOMING MEETINGS

Monthly meetings of the Chicago Herpetological Society begin at 2:00 P.M. on the third Sunday of each month. Please try to join us *in person* at the Notebaert Nature Museum, 2430 N. Cannon Drive, Chicago. The next meeting will take place on Sunday, May 19. **Luke Stevens** from the Lincoln Park Zoo will speak on "From Herps to Hoof Stock: A Zookeeper's Path from Passion to Profession."

The June 16 meeting will be the annual members' **Show & Tell**. All CHS members are encouraged to display one of their favorite animals either at the in-person meeting or via Zoom. Be prepared to give a short (under five minutes) presentation to the group. Don't be shy. Neither age (yours) nor commonness (the animal's) should be a limitation.

Please check the CHS website or Facebook page each month for information on the program.

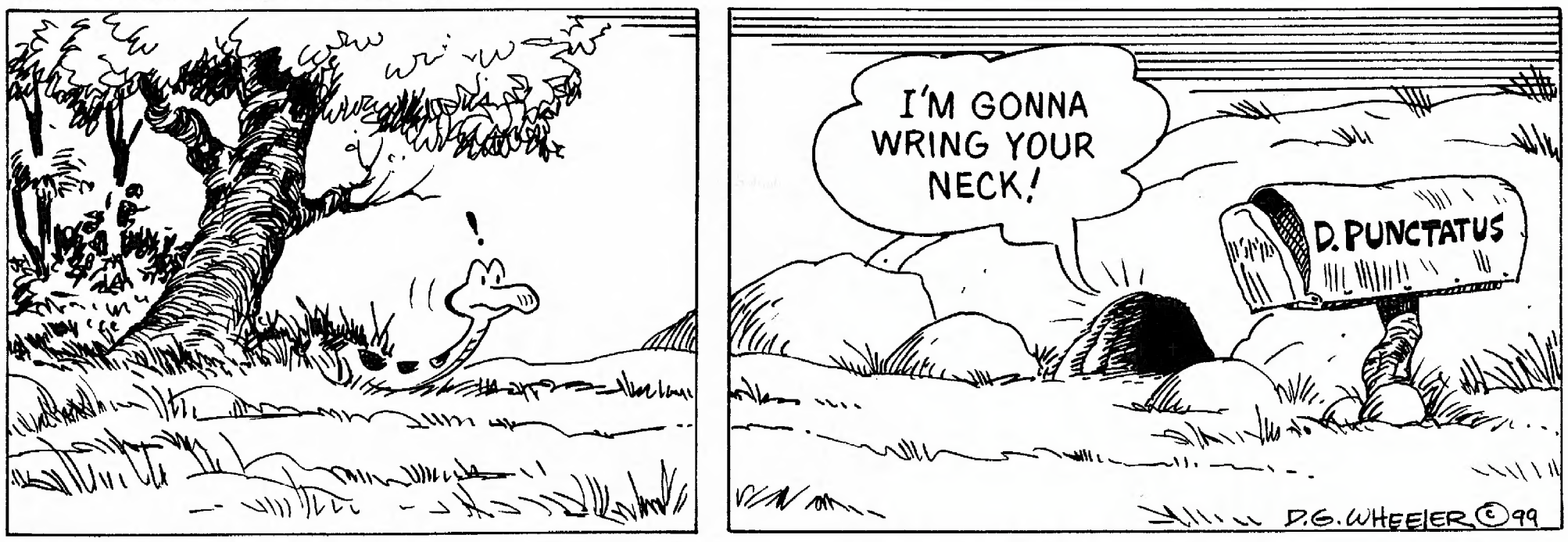
Board of Directors Meeting

Are you interested in how the decisions are made that determine how the Chicago Herpetological Society runs? And would you like to have input into those decisions? The next board meeting will be held online. If you wish to take part, please email: rcrowley@chicagoherp.org.

NEW CHS MEMBERS THIS MONTH

Rachel McHugh
Daniel J. Whiting
Chris Ziegler

THE ADVENTURES OF SPOT



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